Impact of satellite-derived export production on interior DIC distribution. Implications for ocean carbon uptake.

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Introduction

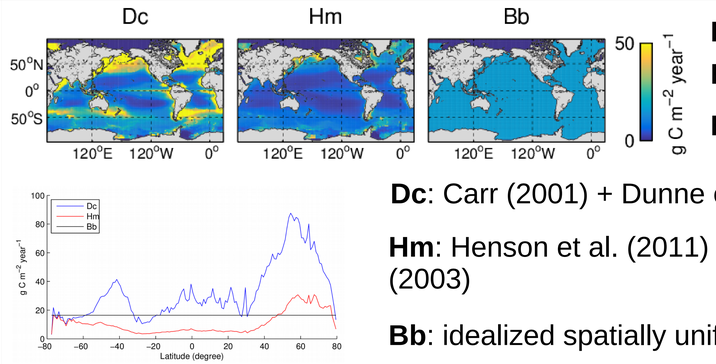
Satellite-derived export production products cover a wide range of spatial distributions and total carbon export.

Such products are often used as reference to calibrate/validate ocean biogeochemical models.

What would be the impact of different export production estimates on the interior DIC distribution ?

What are the consequences for estimates of total ocean C uptake?

Export production estimates considered



Dc = 8.4 Pg C/yr

Hm = 2.5 Pg C/yr

Bb = 5.7 Pg C/yr

Dc: Carr (2001) + Dunne et al. (2005)

Hm: Henson et al. (2011) + Marra et al. (2003)

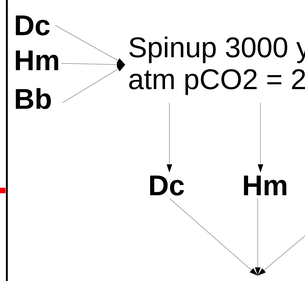
Bb: idealized spatially uniform

Model

Physics: MITgcm ECCO (1 degree) In transport matrix form – i.e. steady-state circulation (Khatiwala 2007)

Biogeochemistry: 4 tracers: DIC, O2, PO4, PO4pre. Fixed stoichiometry (C:O:P). OCMIP protocol for alkalinity. Export (**Dc, Hm** and **Bb**) imposed at base of euphotic zone (120m). Martin's curve below. Above, nutrients are consumed to match imposed export. If nutrients are not enough then export is reduced accordingly.

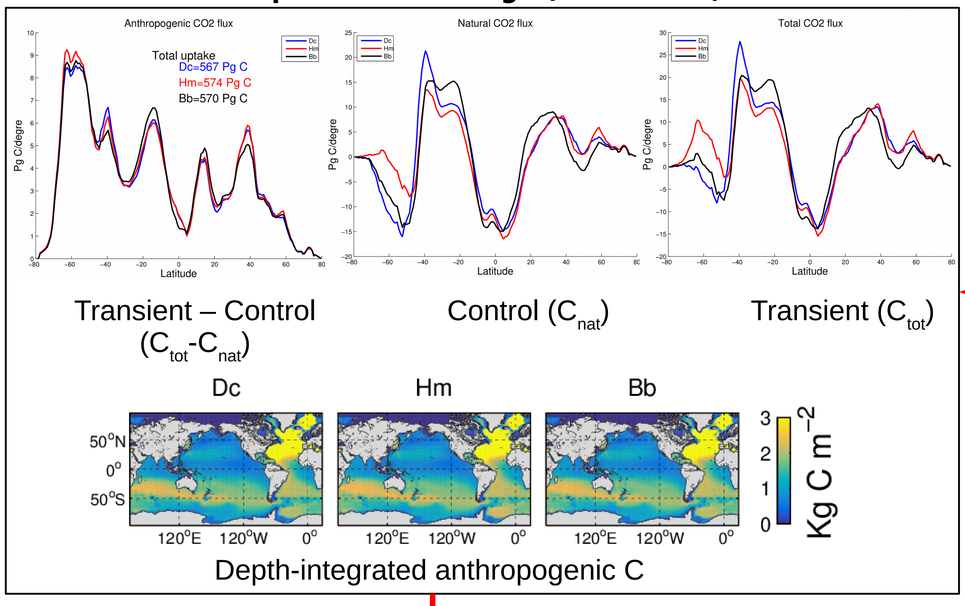
Simulations



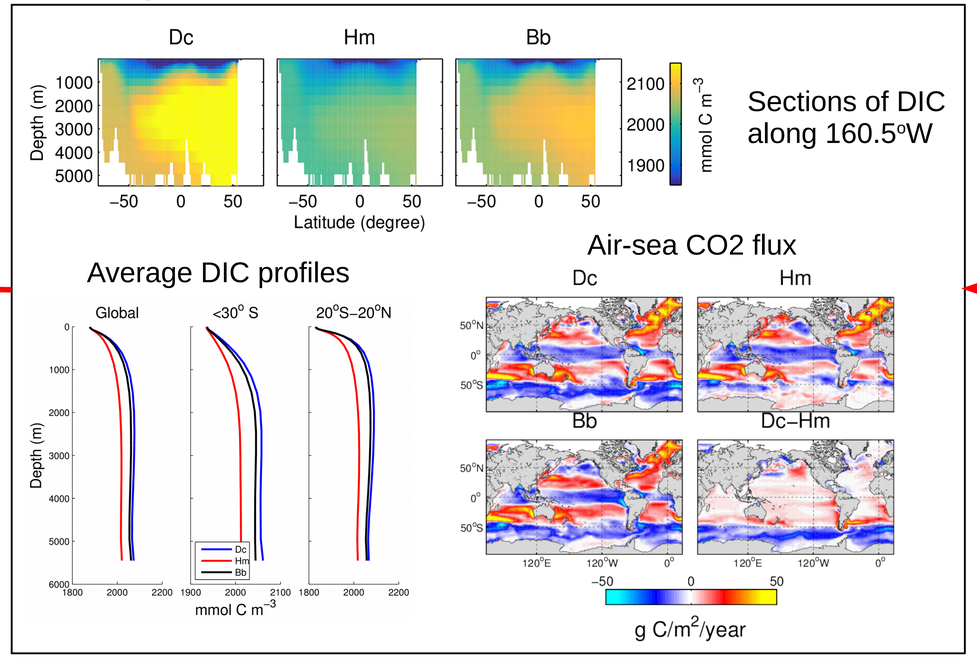
Control 328 years (1772-2099) with atm pCO2 = 280 ppm

Transient 328 years (1772-2099) with atm pCO2 = historical+RCP8.5

Results: Carbon uptake and storage (1772-2099)



Results: pre-industrial DIC and air-sea CO2 flux (Control)



Conclusions

Different satellite export production estimates result in significantly different DIC distributions and steady-state air-sea CO2 fluxes (i.e. natural CO2).

However, different DIC distributions result in very similar uptake of anthropogenic CO2.

Total CO2 fluxes (i.e. what is actually measured) are however, spatially different between DIC distributions because natural CO2 flux is larger than anthropogenic CO2 flux.

Interannual variability is likely to affect C_{nat} flux confounding estimates of C_{ant} uptake.

References

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